

Stable Ag and Au Nanospheres Synthesized by Porphyrin-Assisted Photocatalysis

Leonor Soares,^a Pedro Quaresma,^{a,b} Livia Contar,^a Patricia A. Carvalho^c and Eulalia Pereira^a

- a) REQUIMTE/Faculdade de Ciências, Universidade do Porto, R. Campo Alegre, 687, 4169-007 Porto, Portugal; b) CIGMH/Departamento de Ciências da Vida, FCT-UNL, 2829-516 Caparica, Portugal; c) Departamento de Engenharia de Materiais, IST, Av. Rovisco Pais 1049-100 Lisboa, Portugal
*Corresponding author: leonoririz@gmail.com

Silver and gold nanoparticles have received special attention due to their ease of preparation and their physico-chemical properties.^[1,2] The properties of these nanoparticles grant them a vast applicability in cellular and biomolecular labelling, therapeutical biosensors and also appeared more recently as promising antimicrobial materials.^[1]

A new photocatalytic method for the synthesis of nanospheres was used.^[3] This method involves the reduction of a metallic precursor ($\text{AgNO}_3/\text{HAuCl}_4$) in association with a photocatalyst, a metalloporphyrin of tin (IV), an electron donor agent, triethanolamine (TEA), in the presence of a capping agent. Several capping agents were tested and polyvinylpyrrolidone (PVP) showed to be the most suitable for both metals.^[4] For the optimization of the synthesis, the variation of some parameters was performed, such as the concentration of PVP, metal precursor, and photocatalyst, and their influence was evaluated in order to achieve a greener and more efficient method. The reaction was followed by UV-Vis Spectroscopy, Dynamic Light Scattering (DLS) and Transmission Electron Microscopy (TEM), in order to morphologically characterize the nanoparticles obtained.^[2,7] The stability of the colloidal solutions obtained at several pH and ionic strength was also evaluated.^[5] The ease of exchange of the capping agent was studied by incubation with 11-mercaptopundecanoic acid (MUA).^[6]

References:

- [1] Elechiguerra, L.; Burt, L.; Morones, R.; Bragado, G.; Gao, X.; Lara, H.; Yacaman, M., *J. Nanobiotechnol.*, (2005) 3.
[2] Eutis, S.; Hsu, H-Y; El-Sayed, M.; *J. Phys. Chem. Lett. B*, **109** (2005), 4811-4815.
[3] Song, Y.; Yang, Y.; Medforth, C.; Pereira, E.; Singh, A.; Xu, H.; Jiang, Y; Brinker, C.; Swol, F.; Shelnutt, J., *J. Am. Chem. Soc.*, **126** (2004), 635-645.
[4] Rao, C.; Vivekchand, S.; Biswas, K.; Govindaraj, A., *Dalton Trans* (2007) 3728-3749.
[5] Wanner, M.; Gerthsen, D.; Jester, SS; Sarkar, B.; Schwederski, B.; *Coll. Polymer Sci.*, **283** (2005), 783.
[6] Lin, SY.; Tsai, YT; Chen, C-C; Lin, C-M.; Chen, C-H; *J. Phys. Chem.*, **108** (2004) 2134.
[7] Creighton, A.; Eadon, G.; *J. Chem. Soc., Faraday Trans.*, **87** (1991), 3881-3891.

Acknowledgments: Fundação para a Ciência e a Tecnologia, Portugal for financial support through project PTDC/QUI/64484/2006; P. Quaresma thanks FCT for PhD grant SFRH/BD/17566/2004.

Figures:

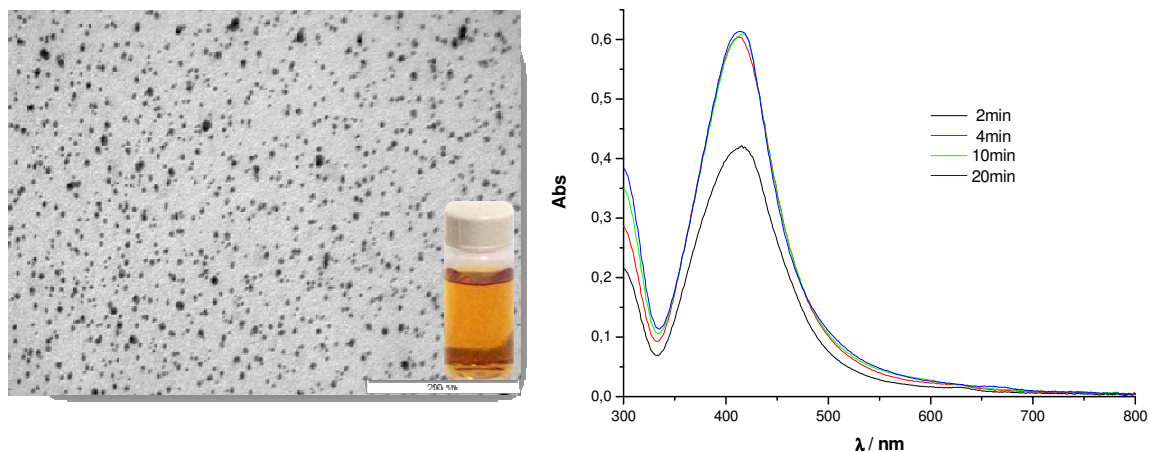


Figure 1 – Representative TEM micrograph of Ag nanoparticles ($5\pm 2\text{nm}$) and the UV-Visible spectra, showing the increase of the Ag Plasmon band centered at 420nm.

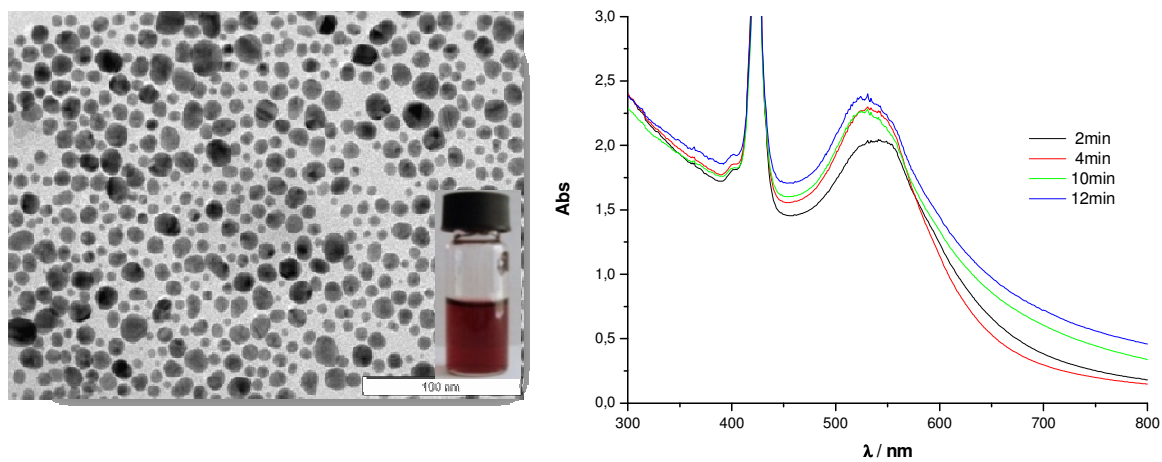


Figure 2 – Representative TEM micrograph of Au nanoparticles ($10\pm 4\text{nm}$) and UV-Vis spectra, showing the increase of the Au Plasmon band at 520nm.